



**Ghana Annual Report 2018**  
**(January-November 2018)**

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**N2Africa**

**Putting nitrogen fixation to work  
for smallholder farmers in Africa**





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## Acronyms

EPDRA	Evangelical Presbyterian Development and Relief Agency
MoFA	Ministry of Food and Agriculture
PFJ	Planting for Food and Jobs
URBANET	Urban Agricultural Network



## 1 Introduction

This report covers the period from January to November 2018. Activities reported in here were carried out in the northern Region of Ghana.

## 2 Results Achieved per Project Objective

### 2.1 Project strategy, coordination and implementation and capacity strengthening

#### 2.1.1 Strategy for implementation and coordination

N2Africa farmers producing grain legumes (cowpea, groundnut and soyabean) have been linked to the major seed companies in Northern Ghana (Heritage Seed Company in the Northern Region and Antika Farms in the Upper West Region) for the production and supply of certified seeds to the company. These two companies have been linked to the Government's Planting for Food and Jobs Program for the supply of certified soyabean seeds. Green-ef, an inoculant distribution and sales company based in Tamale has been linked to IITA-Nodumax for the purchase and distribution of inoculants in Northern Ghana. URBANET, one of the dissemination partners in Northern Region of Ghana, has linked farmers to an agro-input dealer in Savelugu who stocks legume inputs including soyabean seeds, rhizobium inoculants and legume fertilizers.

Two processing companies, Ghana Nuts and Vester Oil have been linked to soyabean producers in the Northern Region of Ghana for the sustainable supply of grains to these two companies. The districts where farmers have been linked to the two companies are presented in Table 1.

**Table 1. Districts allocated to Vester Oil and Ghana Nuts for purchase of soyabean grains**

NO.	Company	Districts
1	Vestor oil	Karaga Gushegu Saboba Chereponi
2	Ghana nuts	Nakpanduri Parts of Yendi / Mion Parts of Nanumba North



a) **Degree training:** Number of students (by gender), areas of studies/topics, research titles, status (completed or not), summary of student (s) findings.

**Table 2. List of MSc and PhD students trained by gender, areas of study, thesis topic and status**

No	Name of Student	Gender	Area of Study	Thesis topic	Status	Degree awarded/To be awarded
1	Godfrey Wilson	M	Soil Science/Rhizobiology	Symbiotic effectiveness and saprophytic competence of selected indigenous rhizobia isolates for groundnut inoculation in northern Ghana	Completed	MPhil
2	Jessica F. Kumah	F	Soil Science	Influence of P sources and rhizobium inoculation on growth, nodulation, N & P uptake and yield of three soyabean genotypes in Tanchera soil series of the northern Guinea savannah zone of Ghana	Completed	MPhil
3	Kennedy Ahlija	M	Agronomy	Response of soyabean to rhizobial inoculation and nitrogen management options in the Southern Guinea savannah zone of Ghana	Completed	MPhil
4	Gifty Kumah	F	Agronomy	Effect of genotype and plant population on growth, nitrogen fixation and yield of soyabean ( <i>Glycine max. L. Merrill</i> ) in the southern Guinea savanna agro-ecological zone of Ghana	Completed	MPhil
5	Wuni Mawiya	M	Agronomy	Effect of genotype and plant population on growth, N-fixation and yield of soyabean in Northern Guinea Savanna zone of Ghana	Completed	MPhil
6	Kwasi Gyan	M	Agribusiness	Farmers' willingness to pay for soyabean inputs in Northern Ghana	Completed	MPhil
7	Ibrahim Issifu	M	Soil science	Effect of liming, phosphorus application and rhizobial inoculation on growth, N-fixation and yield of soyabean	Completed	MPhil



8	Abdul-Rahaman Karim	M	Seed Science	Effects of seed source and storage method on soyabean seed viability and vigour	Completed	MPhil
9	Robert Tumwagewor Atawura	M	Environmental Science Policy and Management	Adoption of Grain Legume Technologies among Farmers in The Upper West Region of Ghana	Thesis submitted for examination	MPhil
10	Michael Kermah	M	Agronomy	Exploring opportunities for grain legume intensification	Writing Thesis	PhD
11	Daniel Brain Akakpo	M	Animal Science	Use of grain legume residues as livestock feed resource for smallholder farmers in northern Ghana	Writing Thesis	PhD



#### Summary of Findings of MPhil Thesis

**Study:** Symbiotic effectiveness and saprophytic competence of selected indigenous rhizobia isolates for groundnut inoculation in northern Ghana.

**Main findings:** Potential exists for the isolation and identification of effective rhizobia strains from Ghanaian soils for the formulation of groundnut inoculant locally.

**Study:** Influence of P sources and rhizobium inoculation on growth, nodulation, N & P uptake and yield of three soyabean genotypes in Tanchera soil series of the northern Guinea savannah zone of Ghana.

**Main findings:** Application of TSP at 30 kg P ha<sup>-1</sup> resulted in significantly higher growth and P uptake compared with MPR and control. Soyabean genotypes showed significant differences in growth, nutrient uptake and grain yield. Rhizobium inoculation had significant effects on nodule number and dry weight but not on grain yield.

**Study:** Response of soyabean to rhizobial inoculation and nitrogen management options in the Southern Guinea savannah zone of Ghana.

**Main findings:** Application of rhizobia inoculant and nitrogen fertilizer did not increase growth and BNF of soyabean. However, mineral N fertilizer application increased grain yield and agronomic efficiency in soyabean.

**Study:** Effect of genotype and plant population on growth, nitrogen fixation and yield of soyabean (*Glycine max. L. Merrill*) in Guinea savanna agro-ecological zone of Ghana.

**Main findings:** Grain yield and nitrogen fixation were not influenced by genotype nor plant population. However, due to its early maturity, Suongpungun appears to be better than the other genotypes

**Study:** Effect of genotype and plant population on growth, N-fixation and yield of soyabean in Northern Guinea Savanna zone of Ghana

**Main findings:** Suongpungun gave the highest grain yield but the least amount of nitrogen fixed while TGX 1955-4F gave the lowest grain yield. The variety TGX 1904-6F gave the highest amount of N fixed.

**Study:** Effect of liming, phosphorus application and rhizobial inoculation on growth, N-fixation and yield of soyabean

**Main findings:** Application of lime at 2 tons ha<sup>-1</sup> and 30 kg ha<sup>-1</sup> P increased growth and yield of soyabean by about 50%.

**Study:** Effects of seed source and storage method on soyabean seed viability and vigour

**Main findings:** Farmers usually use seeds saved from the previous harvest for planting rather than certified seeds. The study also indicated that seed source has a significant effect on seed vigour and viability with significant (positive-negative) differences in seed vigour between farmers' seeds and certified seeds.

**Study:** Farmers' willingness to pay for soyabean inputs in Northern Ghana

**Main findings:** 74% percent of smallholder soyabean farmers in northern Ghana are willing to pay for soyabean inputs and this is linked to farmers previous participation in soyabean demonstrations where these inputs were used. It was found from the study that age of farmer, household size, access to credit, farmer participation in soya demonstrations and gains made from demonstrations influence farmer's use of certified seeds. Access to extension service, participation and benefits from demonstrations and distance to nearest agro-input market influence farmers use of phosphorus fertilizer while use of rhizobia inoculant is influenced by age of farmer, access to credit, membership of farmer group, previous in demonstration and experience in soyabean production.

**Study:** Adoption of grain legume technologies among farmers in the Upper West Region of Ghana

**Main findings:** Adoption of legume inputs is influenced by household size, size of main legume field, intercropping soil fertility, access to credit, access to information and source of seeds.



b) **Non-degree training:** No training was organized during the year..

## 2.2 Delivery and dissemination, sustainable input supply, and market access

### 2.2.1 Farmers reached

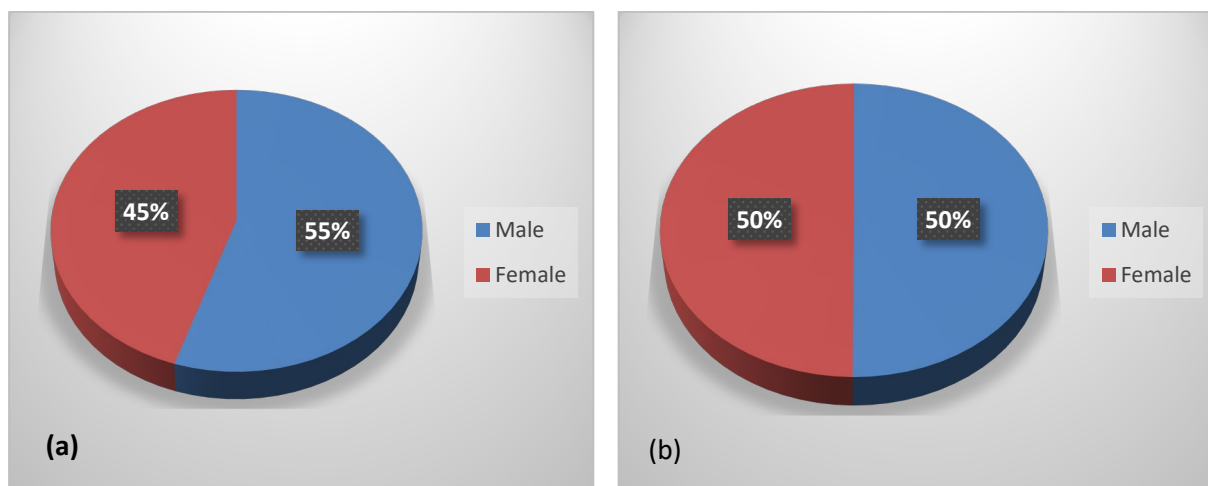


Figure 1. Percentage of male and female farmers reached through (a) Demonstrations and (Field Days)

Table 3. Number of farmers reached in 2018 per gender, partner and dissemination type

Partner	Lead partner by Demonstration		Farmers reached by Demonstration		Lead Farmers by Field Day		Field Attendance Day	
	M	F	M	F	M	F	M	F
URBANET	9	3	191	148	4	2	157	158
EPDRA-YENDI	12	0	179	156	12	0	104	102
TOTAL	21	3	370	304	16	2	261	260

URBANET has integrated N2Africa dissemination modules into other project activities being implemented by the organization. This year, URBANET trained 60 young people on a project called Empower-Emerging Market Foundations (a US-based international NGO) in seed production as income generation activity. These young people (40 female and 20 male) have acquired knowledge and skills in certified seed production. Three demonstration centers were set-up as learning centers where the young people visited every fortnight and practically learned the different practices (seeding, pest control and management, quality control measures, post-harvest management practices) to sharpen their skills and knowledge in producing certified seeds. The training sessions at the learning centers were facilitated by Agriculture Extension Agents from the Seed Inspectorate Division of the Ministry of Food and Agriculture in the districts to ensure quality standards are adhered to and for the subsequent certification of the young people as Certified Seed Producers. The trainees were then supported and supplied with foundation seeds (soyabean, groundnut and cowpea seeds) to set-up their own seed production fields of 1 acre each along-side the training and were monitored by the Seed Inspectors to ensure they are complying with directives and quality standards. Getting the certified seeds and linking of these young people to the seed market has been possible because of the N2Africa project. A total of 60 acres was ploughed for the 60 trainees and provided with the foundation seeds to engage in test production for



certification. At the close of the cropping season in November 2018, our monitoring revealed that 53 of the trainees (88%) had their fields certified by the Inspectorate Division as having met the quality standards in producing certified soyabean seeds for marketing.

Opportunities in the implementation areas that had, or will have, a positive impact on the sustainability of the project's outcomes and impacts is the government programme on soyabean and demand of soyabean for a niche market in China and Turkey. Since last year there has been export of large volumes of soyabean grains into Turkey which has forced the price to rise rapidly in the local market. Soyabean in Ghana is considered as organic and GMO free by default since production is by smallholder farmers who hardly use any external input. This season (2019), The local company which purchases and export soya to Turkey has mobilized about 30,000 farmers to cultivate about 12,000ha of soyabean for export next year. The company is supporting the farmers with credit in the form of land preparation services and other inputs (YARA-legume fertilizer and rhizobium inoculants). GreenEF is supplying them with inoculants from Ibadan while YARA is supplying them with YARA Legume fertilizer. As at now GreenEf has supplied them with a little over one ton of rhizobium inoculant from Ibadan. EPDRA-Yendi, one of N2Africa dissemination partners is backstopping this program with N2Africa technologies. EPDRA-Yendi is training the farmers on inoculant and fertilizer application and other Good Agricultural Practices.

In the Upper East and Upper West Regions where MoFA Staff were used in the implementation of project activities, the Agricultural Extension Agents (AEAs) who were involved in the implementation of the project are also implementing the government's flagship program 'Planting for Food and Jobs' (PFJ). Strategies to make this opportunity more successful is to train AEAs in other districts who were not involved in the implementation of N2Africa in N2Africa technologies.

**Key challenges related to sustainability/risks to continuous dissemination of technologies**

The key challenge related to sustainability of the dissemination activities is price volatility of soyabean in the local market. The price of the grain is highly unpredictable. Whenever the price rises, processors tend to import soyabean from outside to flood the market thereby forcing the price down and discouraging local production by farmers. The current price at the time of harvest hovers around between GHs140 (\$30.43) and GHs160 (\$32.65) per 100kg bag. Huge volumes of soyabean are being shipped to Turkey which has increased the price in the local market.

**2.2.2 Sustainable Input supply**

**Table 4. Quantities of inoculant, seed and fertilizer sold from key input dealers in target areas/PPPs**

Input Type	Quantity sold (kg)
Rhizobia inoculant from Nodumax	125
Rhizobia inoculant from SARI	193.2
Seeds from Heritage Seed Company	87500 kg soyabean; 35,000kg cowpea and 27,800 kg groundnut
Phosphorus fertilizers (TSP and New YARA Legume)	480,000

**Strategies used to improve access to inputs**

**Rhizobia inoculant**

Green-Ef Company, the private sector partner involved in the sale of inoculants, sourced the product directly from Nodumax in Ibadan. Strategies used by Green-Ef to reach out to farmers included sales through projects, direct sales to smallholder farmers, sales through commercial farmers and sales through local agro-input dealers working closely with partners like URBANET. In addition, SARI also produced 235 kg and sold 193.2 kg of inoculant. Out of the 235 kg produced, 27 kg were lost through contamination while 15 kg was used for research.



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## Seeds

Heritage Seed Company sold through the PFJ programme as well as through agro-input dealer networks within areas where N2Africa operates. Seeds were also sold in rural communities through the use of mobile vans, through commercial farmers and through projects.

## Phosphorus fertilizers

Phosphorus fertilizers were sold through YARA Ghana's agro-input dealer networks in Northern Ghana.

## Sustainability of strategies

It appears that marketing of legume inputs is dependent upon projects and very little on purchase by smallholder farmers due to limited access to credit by smallholder farmers. However, with the intervention by government through the PFJ programme and with commercialization of soyabean in northern Ghana, commercial farmers are now beginning to appreciate the use of inputs for legume production. For phosphorus fertilizer, the introduction of subsidy is more likely to increase its use by farmers. Some projects also aimed to provide credit to farmers. Send Ghana, for instance, provided input support at the time that the project had funding. Nucleus farmers from the Advance project received input support from their buyers. However, the number of farmers that received support through this model was very small.

## Key challenge related to sustainability of input supply strategies

Because of storage problems, agro-input dealers are unwilling to stock rhizobia inoculants for sale to farmers which is affecting sales. Also, because of small acreages being cultivated by farmers, volumes that could be sold in a season appears to be low which also increases the transaction cost for the distributors.

While farmers are increasingly becoming aware of the availability of other legume varieties, access to early generation seeds (Breeders and Foundation Seeds) is becoming a challenge for seed producers.

## 2.2.3 Access to Output market

Farmers in Yendi and Saboba already are involved in collective marketing. Currently farmers in seven other districts have been directly linked to two major soyabean processors, Ghana Nuts and Vester Oil (See Table 1 above) for supply of soyabean grains. Harvesting of grains is currently on-going. Strategies being used to ensure continuous access to output markets by farmers, is to link farmers directly to buyers. Key challenges related to sustainability/risks to output market strategies is the quality of grains supplied by farmers.

## 2.3 Empower women to increase benefits from legume production

### 2.3.1 Participation of women in activities

Percentage of women involved in Demonstration activities is estimated at 45% while about 50% of women participated in the Field Day activities. Some women have taken up sale of agro-inputs being promoted by N2Africa. There is a woman agro-input dealer in Savelugu who stock legume inputs like certified seeds, rhizobia inoculant and phosphorus fertilizer for sale to farmers. This woman has been linked up to N2Africa partners who are involved in the production and distribution of inputs (YARA, Heritage Seed Company and Green-Ef) by URBANET.



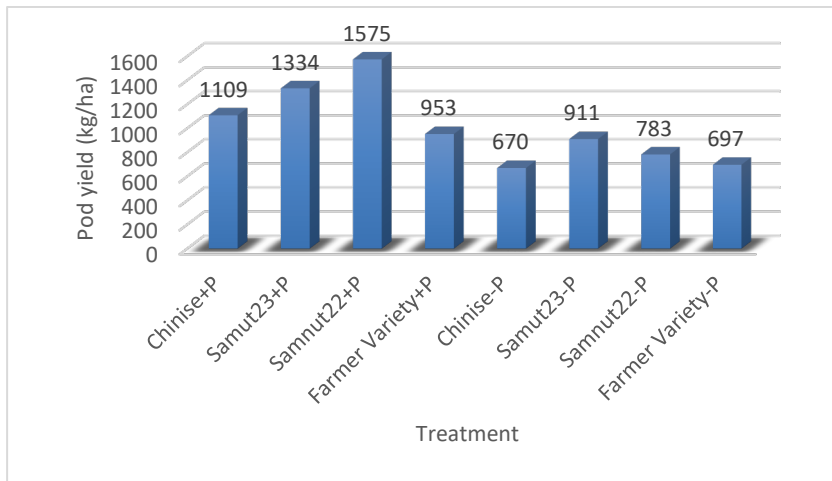
## 2.4 Tailor and adapt legume technologies to close yield gaps and expand the area of legume production within the farm

### 2.4.1 Diagnostic, demonstration and adaptations trials

Twenty-four (24) demonstrations were established, six for each legume crop. Different varieties and were grown with and without New Yara Legume (NYL) fertilizer. Treatments evaluated included:

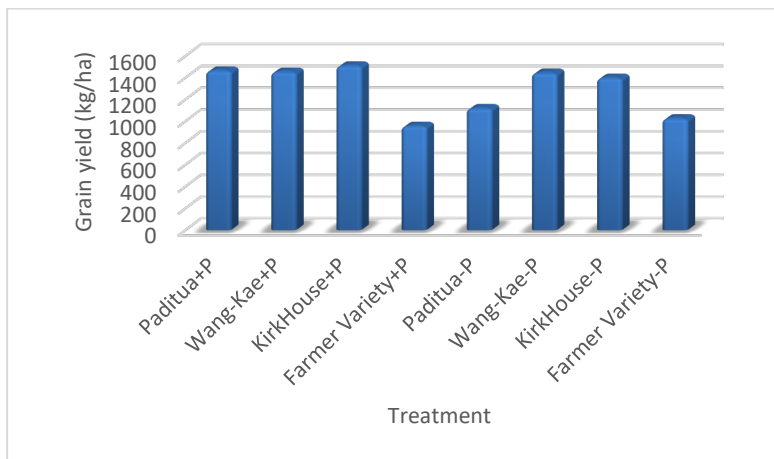
- Groundnut: Samnut 22 +NYL; Samnut 22 -NYL; Samnut 23 +NYL; Samnut 23 -NYL; Chinese +NYL; Chinese -NYL
- Soyabean: TGx1835-10E +NYL; TGx1835-10E -NYL; Afayak +NYL; Afayak -NYL; Suongpungun +NYL; Suongunpun -NYL; Farmers variety +NYL; Farmers variety -NYL
- Cowpea: Paditua +NYL; Paditua -NYL; Apagbala +NYL; Apagbala -NYL; Kirkhouse +NYL; Kirkhouse -NYL; Wangkae +NYL; Wangkae -NYL

Pod yield of groundnut was generally low but there was high response of groundnut to the New Yara Legume fertilizer with the fertilizer application resulting in about 37% increase in yield with the farmer variety to as much as 100% increase in yield with the Samnut 22 variety.



**Figure 2. Pod yield (kg/ha) of groundnut varieties grown with and without NYL fertilizer**

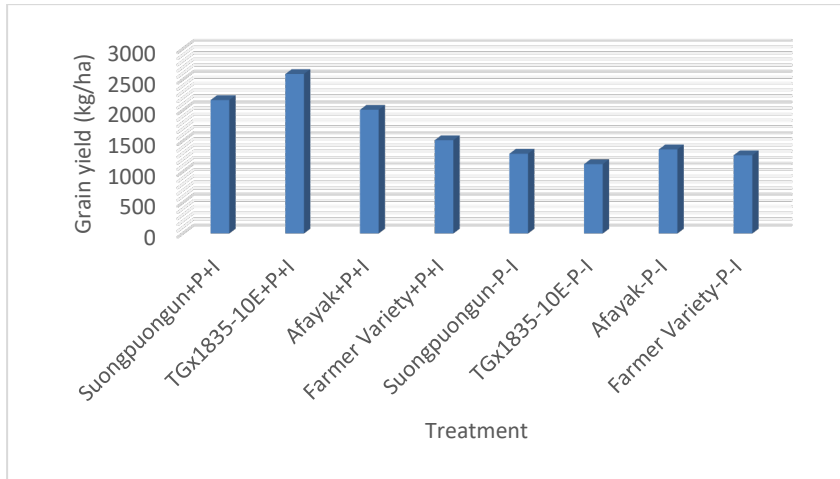
Cowpea yield was generally high, ranging from 954kg/ha with the farmers' variety to 1510kg/ha with KirkHouse, one of the improved varieties with NYL. However, response to P was low except for the Padi-tuya variety (Figure 3).



**Figure 3. Grain yield (kg/ha) of cowpea varieties grown with and without NYL fertilizer**



Soyabean response to inputs (P fertilizer and rhizobium inoculant) was high. Percent increase in yield ranged from 19% with the farmers' variety to 130% with TGx 1835-10E which yielded as much as 2592kg/ha with P+I.



**Figure 4. Grain yield of soyabean varieties grown with and without inputs (NYL and Rhizobium inoculant)**

#### Rhizobiology

**Inoculant production:** A total of 125 kg of soyabean inoculants were imported by Green-Ef from Ibadan for sale to farmers, of which everything was sold. Besides this, SARI produced 235 kg in Ghana of which 193.2 kg were sold. Almost 30 kg were lost through contamination and 15 kg was used for research.

**Inoculant quality control:** Green-Ef sent some samples to the KNUST laboratory for a quality check but did not follow up to get the results. SARI did not send samples to KNUST for quality analysis.

## 2.5 Enable learning and assess impacts at scale through strategic M&E

### 2.5.1 Strategic M&E for Project implementation at Country level

Data collection and feedback processes have resulted in the uptake of technologies by farmers which fit well within farmers production systems. Feedbacks from farmers were used to refine technologies disseminated to farmers. Through these processes some legume crop varieties which were initially introduced to farmers through demonstration were dropped after farmers complained of their unsuitability in their production systems. At the end of every season, the M&E data and other data obtained from on-farm research were used to refine the technologies disseminated to farmers. For instance, some varieties whose disease resistance were broken were removed from the demonstrations and replaced by newly developed varieties by the NARS.

### 2.5.2 Effectiveness of dissemination approaches

A variety of dissemination approaches was used (Video show, radio discussions, demonstrations etc) to enable our technologies to reach farmers beyond our intervention areas. In 2018, because of limited activities of the project, only demonstrations and farmers field days were used to disseminate technologies to farmers.



### 3 Achievements in relation to Specific Project Milestones

Table 5. Achievements with related Milestone Targets

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
<b>Objective 1</b>						
1.3. Engage research, development, private sector, and other relevant partners in each of the target countries	1.3. Partners along the legume input and output value chains cooperate actively towards achieving the overall N2Africa goals.	# of partnerships developed and active	5	5	20	
	1.3.1. By Q2 of year 1, potential partners operating within priority legume value chains mapped	# partners within N2Africa legume value chains mapped	5	5	20	
	1.3.2. By Q3 of year 2, MoUs with priority partners in each of the target countries signed. This links to 2.1.1 and 2.1.2	# MoUs signed with priority legume partners	0	0	8	
1.5. Develop country-specific research and dissemination implementation plans, including a sustainable exit strategy	1.5.1. By Q4 of year 1, country-specific research and dissemination implementation plans formalized, including an exit strategy. Links to 2.4.1	# of specific research and dissemination plans formalized	0	0	11	
	1.5.2. By Q4 of each year, implementation plans are updated based on M&E feedback	# implementation plans updated with M&E feedback				



Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
1.6. Organize seasonal/yearly project-wide and country-specific planning workshops	1.6 Scientists and other stakeholder groups are empowered to further the N2Africa research and development	# Scientist and stakeholder groups leading implementation of activities in N2Africa yearly plans			7	
	1.6.2. By Q4 of each year, 1 or 2 seasonal, in-country implementation plans developed, evaluated, and revised through in-country-planning meetings	# Seasonal in-country plans developed				
1.7. Develop and implement a degree (PhD and MSc)-related research plan	1.7.1. By Q4 of year 1, a research plan, engaging at least 5 PhD and 10 MSc candidates, developed	# of Project wide research plans to engage PhD and MSc students developed & # of PhD and MSc students (men/women)engaged			11	
1.8. Develop and implement a non-degree-related capacity strengthening plan for relevant partners working within legume value chains	1.8.2. By Q4 of each year, at least 4 relevant and demand-driven training materials developed in cooperation with the African Soil Health Consortium (ASHC)	# training materials developed with ASHC				
	1.4. By Q4 of year 5, at least 320 partners trained in N2Africa technologies and approaches	# of persons trained (gender disaggregated data) in N2Africa technologies and approaches & # of N2Africa technologies (by type) in which the persons were trained. <i>(Note: Count the total number of persons trained from the collaborating partners for</i>				



Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
		<i>dissemination. Disaggregate data by gender, topics and ToT level i.e. the type of or the capacity within the trainer is operating like extension officer, partner-M&amp;E officer, agronomist etc.)</i>				
<b>Objective 2</b>						
2.1. Constitute and facilitate in-country/in-region N2Africa stakeholder platforms	2.1. Country-specific inoculant, seed, and fertilizer supply strategies guarantee the sustainable supply of high quality seeds and inoculants and legume-specific fertilizer	# and types of input supply strategies related to seed, fertilizers and inoculants. Performance of various strategies identified in relation to sustainable input supply				
	2.1.1. By Q2 of year 1, N2Africa stakeholder platforms operationalize	# N2Africa stakeholder platforms operational				
	2.1.2. By Q4 of years 1-4, stakeholders agree on specific roles and responsibilities across the various N2Africa objectives	# N2Africa stakeholders with agreed roles and responsibilities				





Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far-Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
2.2. Facilitate <u>N2Africa-led</u> dissemination campaigns in the context of development-to-research learning cycles with specific attention to gender	2.2. Dissemination partners attain/surpass the anticipated number of households targeted and continue to engage in legume intensification post-project	# of target households (men/women) reached ( <i>outcome level: these farmers continue to engage in legume intensification activities after participating in dissemination activities</i> )				
	2.2.1. By Q1 of years 1-4, specific dissemination guidelines for legume intensification assembled	Document indicating specific dissemination guidelines for legume intensification. This links to narratives 2.4 and 2.5 above				
	2.2.2. By Q4 of years 1-4, specific dissemination guidelines evaluated by a preset (see Returns-on-Investment calculations) number of male and female farmers	# of farmers (men/women) who evaluate the guidelines (Note: # of farmers (men/women) who have evaluated technologies and dissemination activities and methods disaggregated by type of dissemination activity)				
2.3. Create widespread awareness on N2Africa technologies and interventions	2.3. Local agro-dealers marketing fertilizer, seed, and inoculants are aligned with grass-root producer groups and input wholesalers and manufacturers	*Volume of seeds, fertilizers and inoculants used per targeted producer groups per land area, *Volume of seeds, fertilizers and inoculants sold by agro-dealers	<b>125kg of inoculants; 133,000kg of seeds and 480,000kg of phosphorus fertilizers</b>	318.2 kginoculants  130,300kg of seeds and 480,000kg of P fertilizers		



Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
	2.3.1. By Q4 of years 1-4, at least 2 media events (e.g., radio, newspaper articles, field days, etc) per country implemented	# of media events implemented				
2.4. Facilitate <u>partner-led</u> dissemination campaigns with specific attention to gender	2.4. A preset (see Returns-on-Investment calculations) number of households engaged in the collective marketing and value addition of legume grains and value-added products	# of individual households (men/women) engaged in collective marketing, value addition of legumes and value added products. Volume of produce sold through collective marketing, volume of value addition products and types of value added products				
	2.4.1. By Q4 of years 2-4, household targets (see Returns-on-Investment calculations), dissemination approaches, and content for partner-led dissemination activities agreed and implemented, with specific attention to gender. This links to 1.5.1	# of partner-led agreements/ partnerships with agreed target households, dissemination approaches & activities focusing on gender				
	2.4.2. By Q4 of years 3-5, feedback on the performance of the dissemination models and the demonstrated content fed back to N2Africa	*Performance reports of dissemination models *Type of performance feedback fed back into N2Africa				



Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
2.5. Facilitate private-public partnerships towards the sustainable supply of inoculants and fertilizer	2.5.1. By Q4 of years 1-4, inoculants available through public-private partnerships, through importation and/or local production, the latter facilitated by the inoculant production pilot plant	# of inoculant outlets in the target areas Volume of inoculants imported and /or produced with the identified outlets				
	2.5.2. By Q4 of years 1-4, legume-specific fertilizer made available to smallholder farmers by fertilizer companies/retailers	# of fertilizer outlets in the smallholder target areas				
		Volume of legume-specific fertilizer at the retail shops				
2.6. Facilitate the establishment of private sector-led and/or community-based legume seed systems	2.6.1. By Q4 of years 1-4, sufficient legume foundation seed produced by private enterprises and/or government institutions	# of private enterprises & government institutions producing legume foundation seed in the target countries.				
		Volume of legume foundation seed produced by private enterprises & government intuitions in the target countries				
	2.6.2. By Q4 of years 1-4, sufficient quality legume seed available to farming communities	Volume of quality legume seed available to target farming communities in the target countries				
2.7. Engage agro-dealer and other last-mile delivery networks in	2.7.1. By Q4 of years 1-2, a minimum number of agro-dealers and other delivery network partners trained in the	# of agro dealers & other delivery network partners trained in storage, handling and use of inoculants				



Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
supplying legume agro-inputs	storage, handling, and use of inoculants					
	2.7.2. By Q4 of years 2-5, agro-dealer and other last-mile delivery networks engaged in the commercial supply to farmers of agro-inputs, including inoculants	# of agro-dealers & other last mile delivery networks in full business of supplying agro-inputs to target farmers including inoculants				
2.8. Establish agri-business clusters around legume marketing and value addition	2.8.1. By Q4 of years 1-4, opportunities for collective marketing and value addition for smallholder farmer associations identified	# of collective marketing and value addition opportunities identified for smallholder farmer associations				
2.9 Assess the effectiveness and efficiency of various input delivery and marketing systems especially for women	2.9.1. By Q4 of year 2, inventory and analysis of input supply and marketing systems conducted across all countries	Report of inventory and Analysis of the input supply & marketing systems in target countries				
<b>Objective 3</b>						
3.1. Sensitize partners, farmer associations, and farming households	3.1. Female farmers increasingly lead N2Africa promotion and dissemination activities	# Female farmers leading N2Africa promotion and dissemination activities				



Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
and mainstream approaches to address gender inequity in farming and decision-making	3.1.1. By Q4 of years 1-4, all partners and households engaged in N2Africa activities that address gender inequity	# of Partner agreements with gender specific activities				
3.2. Assess business opportunities for women in agro-input supply and legume marketing and value addition opportunities	3.2.1. By Q4 of years 2-4, business opportunities for women identified	# business opportunities identified with focus on women				
	3.2.2. By Q4 of years 4-5, at least 2 businesses led by women established per country	# of businesses established and led by women & # of women involved in the businesses established				
3.3. Conduct dissemination campaigns targeting women farmers	3.3. Better knowledge of and access to household-level legume processing tools improves the nutritional status of women and children in at least 2 target countries	# of women using household level-legume processing technologies				
	3.3.1. By Q4 of years 1-4, themes and models for women-specific dissemination campaigns identified	# and types of women specific dissemination campaign themes and models identified.				
	3.3.2. By Q4 of years 2-5, at least 25% of the female farmers participating in the overall N2Africa dissemination activities are also actively engaged in the women-	% female farmers participating in women specific dissemination campaigns				



Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
	specific dissemination campaigns					
3.4. Develop labor-saving pre- and post-harvest legume tools for female farmers	3.4. Women use pre- and post-harvest labor-saving tools, resulting in higher net profits from legume production and processing	# of women using pre- and post-harvest labour-saving tools				
	3.4.1. By Q4 of year 2, prototype labour-saving pre- and post-harvest tools for female farmers validated	# and type of prototype labour-saving pre- and post-harvest tools for female farmers validated				
	3.4.2. By Q4 of years 2-4, labour-saving tools included in the various dissemination campaigns	# pre and post-labour saving tools included in dissemination campaigns				
3.5. Evaluate the impact of environment (E) and management (M) on nutritional quality of legume grain	3.5.1. By Q4 of year 3, relationships between grain nutritional quality and management / environmental conditions quantified	# of relationship equations quantified				
<b>Objective 4</b>						



Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
4.1. Develop variety x inoculant x nutrient management recommendations for the target legumes and legume production areas based on yield gap analysis	4.1. Recommendations for the intensification of legume production result in at least 50% increase in legume productivity	% change in legume productivity among target households participating in adaptation trials (early adoption instead of adaptation trials. Can look at progressive farmers). # of target households (men/women headed) with 50% increased productivity through adaptation trials				
	4.1.1. By Q4 of years 1-4, seasonal research campaigns towards legume intensification and yield gap closure implemented	# and type of Diagnostic trials conducted by N2Africa				
	4.1.2. By Q4 of years 2-4, improved legume production recommendations integrated in the dissemination campaigns	# of improved legume production recommendations (based on diagnostic trials) integrated in dissemination campaigns				
4.2. Develop recommendations for rehabilitation of non-responsive soils for legume production	4.2. Inoculant producers avail improved inoculant formulations for the target legumes resulting in at least 10% increase in legume productivity and BNF	# of inoculant formulations applied/used by inoculant producers for target legumes in core countries (Productivity will be measured by milestone 4.1)				
	4.2.1. By Q4 of year 2, major mechanisms leading to non-responsiveness understood	Major mechanisms contributing to non-responsiveness identified, analyzed & documented				



Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
	4.2.2. By Q4 of years 3-4, prototype rehabilitation measures for non-responsive soils validated	Validated measures(Prototype) for non-responsive soils				
4.3. Intensify crop-livestock interactions through enhancing feed availability of legume crop residues	4.3.1. By Q4 of year 2, niches for use of legume crop residues within and between farms identified	# niches for use of legume crop residues documented				
	4.3.2. By Q4 of years 3-4, feed availability and quality enhanced through appropriate use of grain legume residues	% of livestock feed quality dependent on appropriate use of legume residues				
4.4. Evaluate the medium- to long-term impact of legumes on overall farming system productivity and natural resource conditions	4.4. Overall farming system productivity and soil fertility status is improved through increased legume productivity	% increase in overall productivity and soil fertility of various farming systems as a function of increased legume productivity				
	4.4.1. By Q4 of year 2, at least 1 long term legume monitoring site established per priority region/country approaches	# long term monitoring sites established				
	4.4.2. By Q4 of year 5, the medium- to long-term impact of legumes on overall system productivity and natural resource conditions evaluated using time series analysis and modeling	% contribution of legumes production on overall productivity and natural resources evaluated				





Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
4.5. Isolate, authenticate, and evaluate new strains of rhizobia for the target legumes for high symbiotic effectiveness	4.5.1. By Q4 of years 2-4, at least 50 new strains of effective rhizobia genetically characterized using molecular techniques	# candidate strain evaluated <b># New rhizobia strains collected</b>				
	4.5.2. By Q4 of year 5, newly identified effective rhizobium strains for common bean, cowpea, groundnut conserved in a rhizobium gene bank and at least 5% of these used for inoculant	# Newly identified rhizobium strains conserved in a gene bank. % of identified effective rhizobium strains used for inoculant production				
4.6. Identify elite rhizobium strains and inoculant formulations for beans, groundnut, and cowpea	4.6.1. By Q4 of year 3, at least 5 new effective and elite rhizobia for beans, groundnut, and/or cowpea identified	# new effective and elite rhizobia identified				
	4.6.2. By Q4 of year 5, elite strains used for inoculant production for beans, groundnut, and/or cowpea	# of elite strains used for inoculant production				
4.7. Evaluate competitiveness and survival of introduced rhizobium strains as affected by M x E	4.7.1. By Q4 of year 4, environmental and management conditions affecting the competitiveness and survival of introduced rhizobia elucidated	Documented explanation of Mx E on introduced rhizobium strains				



Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far-Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
4.8. Develop standard operating procedures for the production, quality control and application of rhizobium inoculants	4.8.1. By Q4 of year 2, standard operating procedures of quality control (storage), product registration and application of inoculants used by inoculant producers and retailers	# of inoculant producers and retailers (public private suppliers) using standard operating procedures				
<b>Objective 5</b>						
5.1. Develop an innovative framework for strategic M&E, allowing for timely feedback loops	5.1. National system scientists use the GL x GR x E x M framework and the obtained information to advance legume research for development within their countries	# of national institutions partnering N2Africa in D2R activities (Also # of participating scientists in those institutions) # of national institutions in target countries using GL x GR x E x M for research				
	5.1.1. Throughout the project, a strategic M&E framework provides timely feedback to learning and future planning	Existence of M&E framework that outlines the types of feedback for planning, and provides timely data.				
5.2. Set-up data collection, management, and analysis infrastructure	5.2. Dissemination partners integrate effective and efficient dissemination approaches for legume technologies in their future development initiatives	# of dissemination partners integrating effective and efficient dissemination approaches in their programmes across target countries. (Effectiveness and efficiency of dissemination approaches will be measured by activity 5.6)				
	5.2.1. By Q4 of year 1, data management infrastructure is	Data Management system established with all project data				



Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far-Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
	in place and data population initiated					
5.5. Unravel $G_L \times G_R \times E \times M$ interactions for legume production towards the development of best-fit recommendations	5.5.1. By Q4 of year 4, the relative important of $G_L$ , $G_R$ , $E$ , and $M$ understood for specific legumes and production environments and integrated in improved recommendations	# of quantified relationships integrated in improved recommendations. Best-fit recommendations available to all target legumes in each country				



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## 4 Lessons Learned

- Partnership with the private sector is key to achieve project goals. Partnership with the private sector ensured sustainable supply of legume inputs at the end of the project implementation phase. Although N2Africa in 2018 did not facilitate access to inputs including P fertilizers and inoculants, the private partners involved were able to make these inputs available to farmers. For instance, in 2017, the government supplied huge quantities of New YARA Legume fertilizer to the farmers, but not all were sold in 2017. In 2018, when farmers got to know of the fertilizer, they rushed and purchased everything from the MoFA offices. When those got finished, farmers rushed to YARA to purchase. According YARA, they sold about five trucks each weighing about 180 tons of the NYL fertilizer at unsubsidized price to farmers. Project data collected in 2018 also indicated that about 318.2 tons of soyabean inoculants were sold in 2018 which was above the quantity sold in 2017.
- Access to inputs by farmers has improved over the past three years due to N2Africa's intervention. New varieties of legumes developed by the NARS have been evaluated and different varieties have been identified for the different agro-ecological zones. Certified seeds of these improved varieties have been made available to farmers by collaborating with seed companies for the production of these varieties. This has been made possible by linking farmers trained under the N2Africa project to these seed companies as seed out-growers of these seed companies.
- Rhizobium inoculants, which hitherto were not available in the country, are now available for sale to farmers. Currently, about four brands of inoculants have been registered in the country by the Plant Protection and Regulatory Services Directorate of the Ministry of Food and Agriculture (PPRSD). These include Nodumax, Legume-Fix, Eco-Rhizo Soya and SARFIX.
- Use of phosphorus fertilizer has increased over the years. When we started in 2014, the use of phosphorus fertilizer by farmers for legume production was minimal. Through collaboration with YARA Ghana, TSP was made available in the market in northern Ghana for legume production. Through this collaboration, a special fertilizer blend was developed by YARA and received government subsidy. Through the intervention by N2Africa, legume fertilizers have also been included in the fertilizer subsidy program of the government of Ghana.
- These findings suggest the need to encourage partners to continue the roles they have been playing by integrating N2Africa models in their activities to ensure the sustainability of the N2Africa project. Partners should also be encouraged to work together and also align themselves with the government's PFJ program to improve their input supply system.



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## List of project reports

1. N2Africa Steering Committee Terms of Reference
2. Policy on advanced training grants
3. Rhizobia Strain Isolation and Characterisation Protocol
4. Detailed country-by-country access plan for P and other agro-minerals
5. Workshop Report: Training of Master Trainers on Legume and Inoculant Technologies (Kisumu Hotel, Kisumu, Kenya, 24-28 May 2010)
6. Plans for interaction with the Tropical Legumes II project (TLII) and for seed increase on a country-by-country basis
7. Implementation Plan for collaboration between N2Africa and the Soil Health and Market Access Programs of the Alliance for a Green Revolution in Africa (AGRA) plan
8. General approaches and country specific dissemination plans
9. Selected soyabean, common bean, cowpea, and groundnut varieties with proven high BNF potential and sufficient seed availability in target impact zones of N2Africa Project
10. Project launching and workshop report
11. Advancing technical skills in rhizobiology: training report
12. Characterisation of the impact zones and mandate areas in the N2Africa project
13. Production and use of rhizobial inoculants in Africa
18. Adaptive research in N2Africa impact zones: Principles, guidelines and implemented research campaigns
19. Quality assurance (QA) protocols based on African capacities and international existing standards developed
20. Collection and maintenance of elite rhizobial strains
21. MSc and PhD status report
22. Production of seeds for local distribution by farming communities engaged in the project
23. A report documenting the involvement of women in at least 50% of all farmer-related activities
24. Participatory development of indicators for monitoring and evaluating progress with project activities and their impact
25. Suitable multi-purpose forage and tree legumes for intensive smallholder meat and dairy industries in East and Central Africa N2Africa mandate areas
26. A revised manual for rhizobium methods and standard protocols available on the project website
27. Update on Inoculant production by cooperating laboratories
28. Legume seeds acquired for dissemination in the project impact zones
29. Advanced technical skills in rhizobiology: East and Central African, West African and South African Hub
30. Memoranda of Understanding are formalized with key partners along the legume value chains in the impact zones
31. Existing rhizobiology laboratories upgraded
32. N2Africa Baseline report



33. N2Africa Annual Country reports 2011
34. Facilitating large-scale dissemination of Biological Nitrogen Fixation
35. Dissemination tools produced
36. Linking legume farmers to markets
37. The role of AGRA and other partners in the project defined and co-funding/financing options for scale-up of inoculum (Banks, AGRA, industry) identified
38. Progress towards achieving the vision of success of N2Africa
39. Quantifying the impact of the N2Africa project on Biological Nitrogen Fixation
40. Training agro-dealers in accessing, managing and distributing information on inoculant use
41. Opportunities for N2Africa in Ethiopia
42. N2Africa project progress report month 30
43. Review & Planning meeting Zimbabwe
44. Howard G. Buffett Foundation – N2Africa June 2012 Interim Report
45. Number of extension events organized per season per country
46. N2Africa narrative reports Month 30
47. Background information on agronomy, farming systems and ongoing projects on grain legumes in Uganda
48. Opportunities for N2Africa in Tanzania
49. Background information on agronomy, farming systems and ongoing projects on grain legumes in Ethiopia
50. Special events on the role of legumes in household nutrition and value-added processing
51. Value chain analyses of grain legumes in N2Africa: Kenya, Rwanda, eastern DRC, Ghana, Nigeria, Mozambique, Malawi, and Zimbabwe
52. Background information on agronomy, farming systems and ongoing projects on grain legumes in Tanzania
53. Nutritional benefits of legume consumption at household level in rural sub-Saharan Africa: Literature study
54. N2Africa project progress report month 42
55. Market analysis of inoculant production and use
56. Soyabean, common bean, cowpea, and groundnut varieties with high Biological Nitrogen Fixation potential identified in N2Africa impact zones
57. A N2Africa universal logo representing inoculant quality assurance
58. M&E workstream report
59. Improving legume inoculants and developing strategic alliances for their advancement
60. Rhizobium collection, testing and the identification of candidate elite strains
61. Evaluation of the progress made towards achieving the Vision of Success in N2Africa
62. Policy recommendation related to inoculant regulation and cross-border trade
63. Satellite sites and activities in the impact zones of the N2Africa project
64. Linking communities to legume processing initiatives
65. Special events on the role of legumes in household nutrition and value-added processing



66. Media events in the N2Africa project
67. Launching N2Africa Phase II – Report Uganda
68. Review of conditioning factors and constraints to legume adoption and their management in Phase II of N2Africa
69. Report on the milestones in the Supplementary N2Africa grant
70. N2Africa Phase II Launching in Tanzania
71. N2Africa Phase II 6 months report
72. Involvement of women in at least 50% of all farmer-related activities
73. N2Africa Final Report of the First Phase: 2009-2013
74. Managing factors that affect the adoption of grain legumes in Uganda in the N2Africa project
75. Managing factors that affect the adoption of grain legumes in Ethiopia in the N2Africa project
76. Managing factors that affect the adoption of grain legumes in Tanzania in the N2Africa project
77. N2Africa Action Areas in Ethiopia, Ghana, Nigeria, Tanzania, and Uganda in 2014
78. N2Africa Annual Report Phase II Year 1
79. N2Africa: taking stock and moving forward. Workshop report
80. N2Africa Kenya Country report 2015
81. N2Africa Annual Report 2015
82. Value Chain Analysis of Grain Legumes in Borno State, Nigeria
83. Baseline report Borno State
84. N2Africa Annual Report 2015 DR Congo
85. N2Africa Annual Report 2015 Rwanda
86. N2Africa Annual Report 2015 Malawi
87. Contract Sprayer in Borno State, Nigeria
88. N2Africa Baseline Report II Ethiopia, Tanzania, Uganda, version 2.1
89. N2Africa rhizobial isolates in Kenya
90. N2Africa Early Impact Survey, Rwanda
91. N2Africa Early Impact Survey, Ghana
92. Tracing seed diffusion from introduced legume seeds through N2Africa demonstration trials and seed-input packages
93. The role of legumes in sustainable intensification – priority areas for research in northern Ghana
94. The role of legumes in sustainable intensification – priority areas for research in western Kenya
95. N2Africa Early Impact Survey, Phase I
96. Legumes in sustainable intensification – case study report PROIntensAfrica
97. N2Africa Annual Report 2016
98. OSSOM Launch and Planning Meeting for the west Kenya Long Rains 2017
99. Tailoring and adaptation in N2Africa demonstration trials
100. N2Africa Project DR Congo Exit Strategy



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101. N2Africa Project Kenya Exit Strategy
  102. N2Africa Project Malawi Exit Strategy
  103. N2Africa Project Mozambique Exit Strategy
  104. N2Africa Project Rwanda Exit Strategy
  105. N2Africa Project Zimbabwe Exit Strategy
  106. N2Africa Annual Report 2017
  107. N2Africa review of policies relating to legume intensification in the N2Africa countries
  108. Stakeholder Consultations report
  109. Dissemination survey Tanzania
  110. Climbing bean x highland banana intercropping in the Ugandan highlands
  111. N2Africa Annual Report 2018
  112. N2Africa Annual Report 2018 Ethiopia
  113. N2Africa Annual Report 2018 Ghana





## Partners involved in the N2Africa project

